

REMARKS

Favorable reconsideration of this application in light of the preceding amendments and the following remarks is respectfully requested.

No claims having been cancelled or added, the Applicants respectfully submit that claims 1-51 remain properly under consideration in this application.

The Applicants respectfully note that the present Action does not indicate that the drawings have been accepted by the Examiner. The Applicants respectfully request that the Examiner's next communication include an indication as to the acceptability of the filed drawings or as to any perceived deficiencies so that the Applicants may have a full and fair opportunity to submit appropriate amendments and/or corrections to the drawings.

The Applicants acknowledge that the application names joint inventors and contends that the subject matter disclosed and claimed herein was commonly owned at the time the inventions were made. Accordingly, the Applicants acknowledge their obligations under 37 C.F.R. § 1.56 regarding the accurate designation of inventorship, but respectfully contend that no correction or supplemental information is warranted at this time.

Rejections under 35 U.S.C. § 103

Claims 1-4, 7, 10-16, 21-27, 29, 30, 36-39, 41-46 and 48-51 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Kajiura et al.'s U.S. Patent No. 5,907,382 ("Kajiura") in view of Shibuya et al.'s U.S. Patent No. 5,614,271 ("Shibuya"). The Applicants respectfully traverse this rejection for the reasons detailed below.

The Applicants respectfully note that Kajiura is directed to, in part, forming a metal oxide protective layer on a polymeric substrate, to form:

a transparent conductive substrate, comprising a transparent composite base having a ***transparent heat resisting resin base*** and a silicon oxide layer, the silicon oxide layer being formed on at least one of two main surface of the transparent heat resisting resin base, and a transparent electrode layer formed on the silicon oxide layer of the transparent composite base, wherein the silicon oxide layer comprises [sic] ... coating a solution of polysilazane on the ***transparent heat resisting resin base*** and hydrolyzing and oxidizing polysilazane.

Kajiura, col. 3, lines 39-56 (emphasis added). Kajiura's use of the transparent heat resisting resin base limits the temperature range to which the structure may subsequently be exposed:

The resin base mainly composed of thermosetting type allylated polyphenylene ether has excellent optical characteristics such as low optical anisotropy and low haze value. The glass transition temperature of the resin base is as high as around 250° C.

Kajiura, col. 5, lines 56-60.

To convert polysilazane into a silicon oxide, if polysilazane is simply heated, it takes several hours at a ***high temperature of around 250° C.*** However, such a converting process that takes a long time at a high temperature is not practical. ***The transparent heat resisting resin base cannot withstand such a high temperature.*** However, the inventors of the present invention discovered the method for accelerating the conversion to silicon oxide at a lower temperature.

Kajiura, col. 13, lines 41-48 (emphasis added). In light of the upper temperature limit imposed by the resin base, Kajiura disclosed a process wherein:

Thereafter, by hydrolysis and oxidizing reaction of the dried [polysilazane] film, ***a converting reaction to silicon oxide is accelerated at a low temperature.*** The oxidizing reaction can be performed for example by exposing the polysilazane film to ozone or dipping it in a solution of hydrogen peroxide. On the other hand, the hydrolysis reaction can be performed by exposing the polysilazane film to a high temperature and high humidity atmosphere.

After such processes are performed, when the polysilazane film is baked at a temperature in the range from 100 to 150° C., the polysilazane film is converted to a silicon oxide layer. The situation of which the polysilazane film is converted to the silicon oxide is observed by an infrared ray absorption spectrum. In other words, the infrared ray absorption decreases due to Si-N bond, N-H bond, and Si-H bond. In addition, the infrared ray absorption increases at a wave number of around 1100 cm^{-1} due to Si-O bond. Finally, the conversion to SiO_2 is confirmed by SIMS.

Kajiura, col. 13, line 58 to col. 14, line 8 (emphasis added).

The Applicants respectfully submit, therefore, that Kajiura was motivated by the presence of the resin base to use an oxidant (for example, a hydrogen peroxide solution) for sensitizing the polysilazane layer for subsequent thermal conversion at temperatures lower than those used in conventional conversion processes. The Applicants respectfully submit that Kajiura does not teach or suggest using an oxidant solution as other than a sensitizing agent before performing a thermal conversion to obtain the desired silicon dioxide.

Further, as noted by the Examiner, Action at 3, Kajiura fails to teach or suggest performing the disclosed processes on a semiconductor, rather than polymeric, substrate, the baking step, using oxygen or an ozone solution as the oxidant, the recited

concentrations, the recited structures or the recited method steps necessary in the fabrication of semiconductor devices.

The Applicants respectfully submit that Shibuya is directed to a method of forming a metallic oxide (SiO₂) film by:

- (a) coating the surface of the substrate with a coating solution containing a polysilazane having a weight-average molecular weight in the range from 1000 to 5000 as dissolved in an organic solvent to form a coating layer;
- (b) drying the coating layer by heating according to a schedule comprising a stage of heating within a range of temperature from 80° C. to 140° C. for a length of time from 2 minutes to 5 minutes followed by a continuous or stepwise increase of the temperature to reach 240° C. taking 2 minutes to 5 minutes and a stage of heating within a range of temperature from **240° C. to 350° C.** for a length of time from 2 minutes to 5 minutes;
- (c) irradiating the thus dried coating layer at a temperature in the range from **240° C. to 350° C.** with ultraviolet light for 0.5 minute to 3 minutes; and
- (d) subjecting the coating layer after the ultraviolet irradiation to a **baking treatment** for 15 minutes to 90 minutes.

Shibuya, col. 3, lines 8-25 (emphasis added). According to Shibuya, with regard to the irradiation step (c):

It is ***essential in the inventive method*** that the ***ultraviolet irradiation treatment*** of the coating layer is performed ***at a temperature in the range from 240° to 350° C.***

Shibuya, col. 4, lines 58-60 (emphasis added), and that the baking treatment of step (d) involves subjecting the coating layer, which was previously irradiated with UV light while maintained at a temperature within a range of 240-350° C.:

... to a baking treatment in a baking furnace at a temperature in the range from **350° to 800° C.** for a length of time in the range from 15 to 90 minutes ***to complete conversion of the polysilazane into silica.*** When a wiring layer of a metal such as aluminum is provided between the substrate surface and the coating film of the polysilazane, ***the baking temperature should be in the range from 350° to 450° C.*** in consideration

of the low heat resistance of the metal while the baking temperature can be high enough in the range *from 450° to 800° C. when such a metallic wiring layer is not provided.*

Shibuya, col. 4, line 65 to col. 5, line 8 (emphasis added).

Accordingly, the Applicants respectfully maintain that one of ordinary skill in the *semiconductor* manufacturing arts would be aware that polysilazane SOG layers could be safely processed at temperatures sufficient to convert the polysilazane to silicon dioxide without an additional wet process. The Applicants also respectfully contend that one of ordinary skill in the semiconductor arts would not be motivated to add a new “wet” process to a process that was supposedly capable of generating a “very dense silica-based coating film,” Shibuya, col. 5, line 14.

Similarly, the Applicants respectfully contend that one of ordinary skill with depositing films on transparent resin materials for use with LCD displays would not seek guidance from a reference directed to semiconductor device fabrication which defines as “essential” processing temperatures well above the highest temperature that can reasonably be endured by the resin material.

With respect to Shibuya’s “teaching” regarding the use of ozone to convert the polysilazane layer to an oxide, Action at 3, the Applicants respectfully note that according to Shibuya, it was the subsequent baking process at a temperature of at least 350° C. that was required to “convert the polysilazane film to a silica-based coating film.” Shibuya, col. 5, lines 62-63. The Applicants respectfully contend that Shibuya’s disclosure in this regard is more fairly read as “teaching away” from use of ozone without a subsequent baking process.

With respect to Shibuya's "teaching" regarding the use of a mixture of oxygen and water vapor as the oxidants, Action at 3, the Applicants respectfully note that absent the UV irradiation, the use of such oxidants even at 250° C. was deemed to result in an "incomplete conversion of the coating layer of polysilazane into a silica-based coating film." Shibuya, col. 6, lines 53-54. The Applicants respectfully contend that Shibuya's disclosure in this regard is more fairly read as "teaching away" from the use of such oxidants in the manner suggested.

The Applicants, therefore, respectfully contend that when the teachings of the references are properly considered as a whole, MPEP § 2141.02, the fundamental differences in the substrates and the corresponding effect on the processing steps and the operable and "essential" temperature ranges provided in the references would be sufficient to prevent one of ordinary skill from selectively combining the disparate process steps in the manner suggested.

Further, the Applicants respectfully suggest that no teaching or suggestion has been identified in the applied references with regard to densifying the SOG layer prior to treatment with an oxidant solution, *e.g.*, claim 13, increasing the HF etch resistance of the SOG layer by at least 50%, *e.g.*, claim 14, or partially oxidizing the polysilazane in the SOG layer prior to treatment with an oxidant solution, *e.g.*, claims 15 and 36.

The Applicants also respectfully contend that the applied references, whether singly or in combination, fail to teach or suggest the particular embodiment of the invention recited in claim 36 wherein the SOG layer is first baked to achieve a partial conversion of the polysilazane to silicon dioxide and only then treated with an oxidant

solution to convert the remaining polysilazane and complete the formation of the silicon dioxide layer.

The Applicants respectfully request, therefore, that the present rejections be reconsidered and withdrawn accordingly.

Allowable Subject Matter

The Applicants note with appreciation the Examiner's indication that claims 5, 6, 8, 9, 17-20, 28, 31-33, 40 and 47 are objected to as depending from a rejected base claim and would, therefore, be allowable if rewritten in independent form incorporating limitations of all included claims. As reflected by the remarks above, however, the Applicants respectfully contend that these claims and various of the claims from which they depend are allowable in their present form and that no such rewriting of the claims is warranted by this record.

Allowed Claims

The Applicants note with appreciation the Examiner's indication that claims 34 and 35 are allowed.

CONCLUSION

In view of the remarks presented above, the Applicants respectfully submit that each of the pending objections and rejections have been addressed and overcome, leaving each of the claims of the present application in condition for allowance. A notice to that effect is respectfully requested.

If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to contact the undersigned.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge any underpayment or non-payment of any fees required under 37 C.F.R. §§ 1.16 or 1.17, or credit any overpayment of such fees, to Deposit Account No. 08-0750, including, in particular, extension of time fees.

Respectfully submitted,

HARNESS, DICKY & PIERCE, P.L.C.

By: _____

John A. Castellano
Reg. No. 35,094
P.O. Box 8910
Reston, VA 20195
(703) 668-8000

By No. 35,416

JAC/GPB